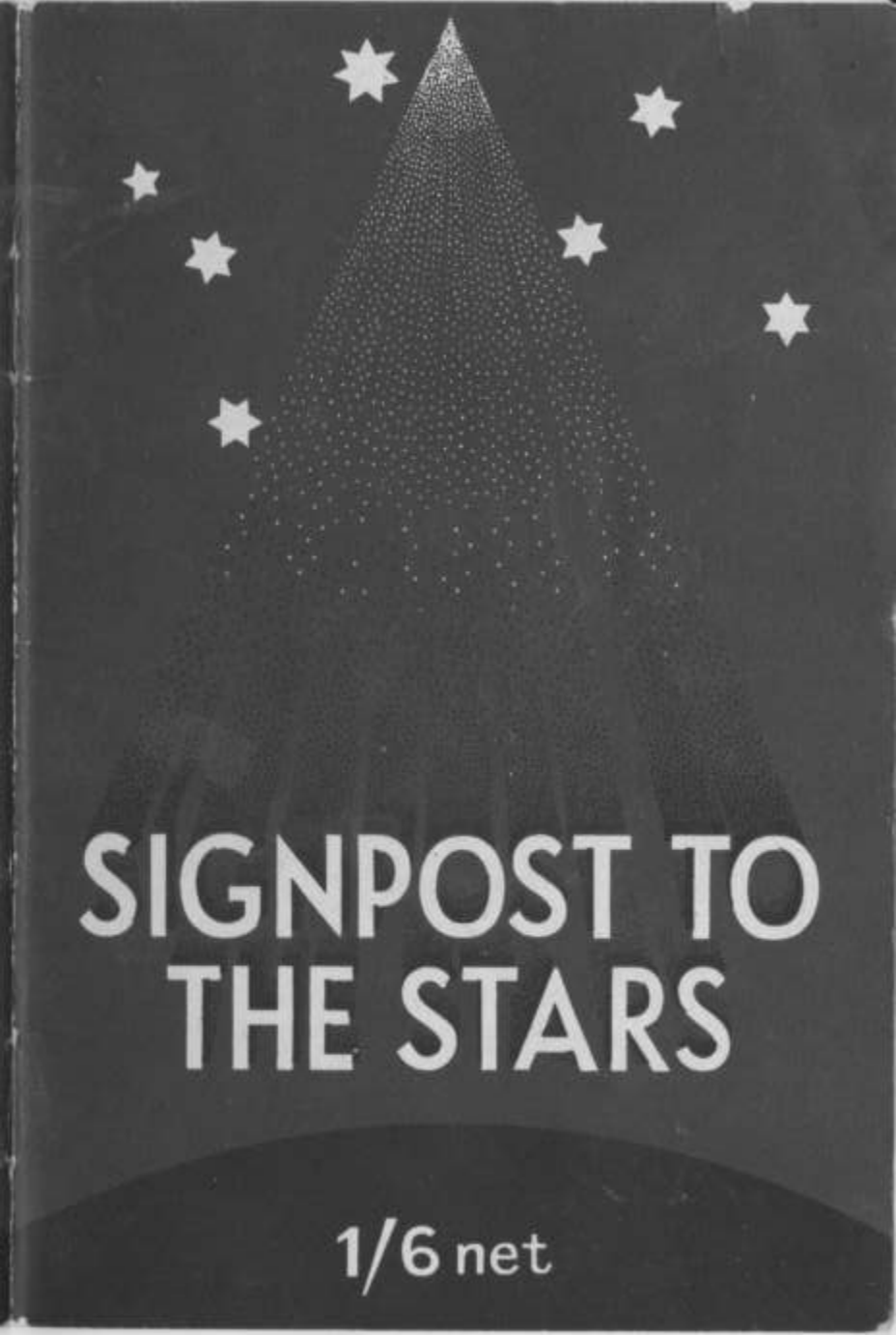
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INTRODUCTION

The many literary and poetic references to stars that come out at night are disproved by science, which has long established that they are there all the time, and can be seen during daylight with the aid of a good telescope. The unaided eye cannot see them against the apparently brighter light of the nearest star to the earth—the one we know as the Sun. For the Sun is only a star, and not a very big one either. Its light is bright only because it is, by comparison with the other stars, so near to us.

All the stars may be regarded as other suns, of greatly varying sizes, at very different distances from the Sun, and from each other. A catalogue of 1,025 stars was compiled by the Egyptian astronomer and geographer—Ptolemy, in the year A.D. 137. As that was of course long before the invention of the telescope, it may well be said that with normal eyesight we can see about one thousand stars with the naked eye. A good pair of field glasses will increase the number of stars visible to about fifty thousand, and even the telescope used by good amateur astronomers will show about 300,000 stars. The telescope at Mount Wilson, in the United States, has a reflector 100 inches across, and reveals one million million (1,000,000,000,000) stars. In 1948, the largest telescope in the world, with a 200-inch reflector, was erected on Mount Palomar, California. It has enabled many times that vast number of stars to be seen and charted, and is being used for a new systematic survey of the heavens. The radio telescope at Jodrell Bank, Cheshire, is the largest in the world, and came into action in 1957. It operates by the collection of radio waves from outer space, where it can explore regions of space 1,000 times greater than those visible through optical instruments.

Of greater interest than the increased number of stars revealed by a telescope is their altered appearance. Single points of light may be revealed as twin stars of different colours, an occasional example of which will be described later. A knowledge of about

thirty stars or groups of stars is sufficient to make the heavens seem very familiar to us, so that the million million stars of the Mount Wilson telescope need not appal us. To aid them in mapping and cataloguing stars astronomers have evolved a system of either naming or numbering them. Groups of stars are called constellations, and the stars forming these groups are distinguished either by a letter of the Greek alphabet, or by a number. In addition, some of the stars, chiefly conspicuous ones, have special names of their own. To give an example, Alpha Canis Majoris is the most brilliant star of the group Canis Major, and is also called Sirius, or more popularly the Dog Star. We shall only try to recognize important constellations and individual stars that are of exceptional interest or have been the subject of special research, and of course that will include all those stars which are so conspicuous as to arouse our present interest. In the diagrams the names of constellations are in capitals, and the names of individual stars in small letters.

It is hoped that the descriptive particulars given of certain stars will add to the attraction of the guide, and that the planets, at once the most interesting to observe and difficult to explain to a beginner, will not be regarded as "glossed over." A brief note on extra-galactic nebulae ensures a knowledge that in one sense at least may be regarded as extensive. Since it was not practicable to draw all the diagrams on the same scale, it was thought helpful in a number of instances to give some indication of a constellation's apparent extent above us.

F. E. BUTLER.

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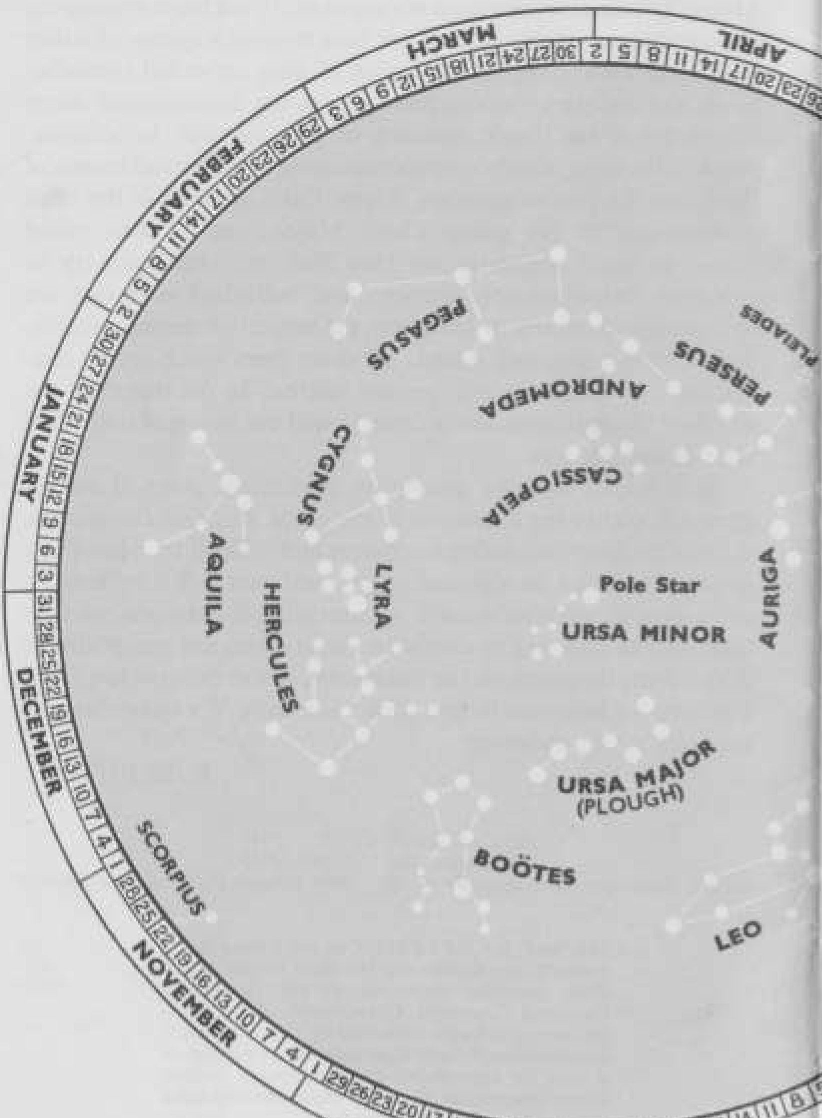
CAN YOU RECOGNISE



If so, this little book is not intended for you but only for those who are bewildered by the task of attempting to arrange in constellations, as do the astronomers, the seemingly endless multitude of stars seen in the Heavens on a clear and starry night. The ensuing pages will serve as a signpost of the principal constellations and the most familiar stars. It may be found useful to locate on the chart each additional group as observed, meanwhile paying particular attention to its position among its neighbours.

This chart displays on one map the whole of the constellations of the northern heavens mentioned in this guide, visible in Britain at some time of the year though not all at the same time. The dates round its edge show when that part of the heavens is due north at midnight. The actual stars visible would be contained in a circle having a diameter slightly less than three quarters of the whole chart, and so placed on the chart that it is on the opposite edge to the date required. The diameter of the chart being 5¼ inches, it is a good practice to cut a 4-inch circle of transparent paper, draw a diagonal line on it as a north to south guide, and lay it on the chart to show what area is visible at midnight on a given date. The diagonal line should cross the Pole Star, and point to the date. There will be a gap between the edge of the paper and the edge of the chart, and it will be found that the Pole Star is always half way between the centre of the transparent disc and its momentarily northern edge.

On a clear and dark night, a band of faint light can be seen right across the sky. At midnight it runs very approximately from north to south in midsummer and midwinter, and from east to west in spring and autumn, but its position changes steadily, in common with all the stars. Actually it is a band of stars known as the Milky Way, about which much has been revealed to us by the application of photography to its study. A time exposure with a camera collects much more light than the instantaneous vision of the human eye, and reveals stars that are otherwise invisible. In the case of the Milky Way patches of the photograph are white throughout, proving the very great number of stars that must appear in that direction.

As the stars making that patch cannot be touching each other, their distances from each other and from us, must be enormous. Looking at a wood from a distance creates a similar illusion, for though it is known to consist of separate trees, some perhaps even widely separated, yet its appearance seems to be that of a dense mass of foliage and brown trunks.

While the stars are in fact very far from each other, the brighter ones seem to be in groups. These are usually referred to as constellations each with its own name, and many individual stars also have their own names. In both cases these are taken from mythology, since ancient civilizations loved to account for the presence of the stars by highly imaginative stories of the adventures of their gods, and certain favoured mortals. A well developed fancy is required to see the figures the stars are said to represent, and they will be omitted from this practical guide.

An exception to the rule that the stars of one constellation may in fact be widely separated is that called the Plough, the stars of which are known to be a group travelling together. It is known also as the Great Bear (Ursa Major), Charles' Wain, and in America as "the Dipper." Both the Plough and the Dipper are the most expressive titles, since it can be seen to represent either. The seven largest stars in the constellation form a group roughly outlining the shape of a plough, and the last two stars point to a single bright star—the Pole Star, round which all the constellations

appear to revolve. The Pole Star is almost directly over the North Pole, and as in this country it appears roughly half way between the zenith (i.e. overhead) and the northern horizon, and always occupies a northerly position, it is at night a most useful guide to direction.

The Plough is the most widely known of all groups of stars and if you cannot distinguish it already, try to recognize it from the diagram and notes given here, and get a knowledgeable friend to confirm your opinion. It can serve as the signpost to the heavens.

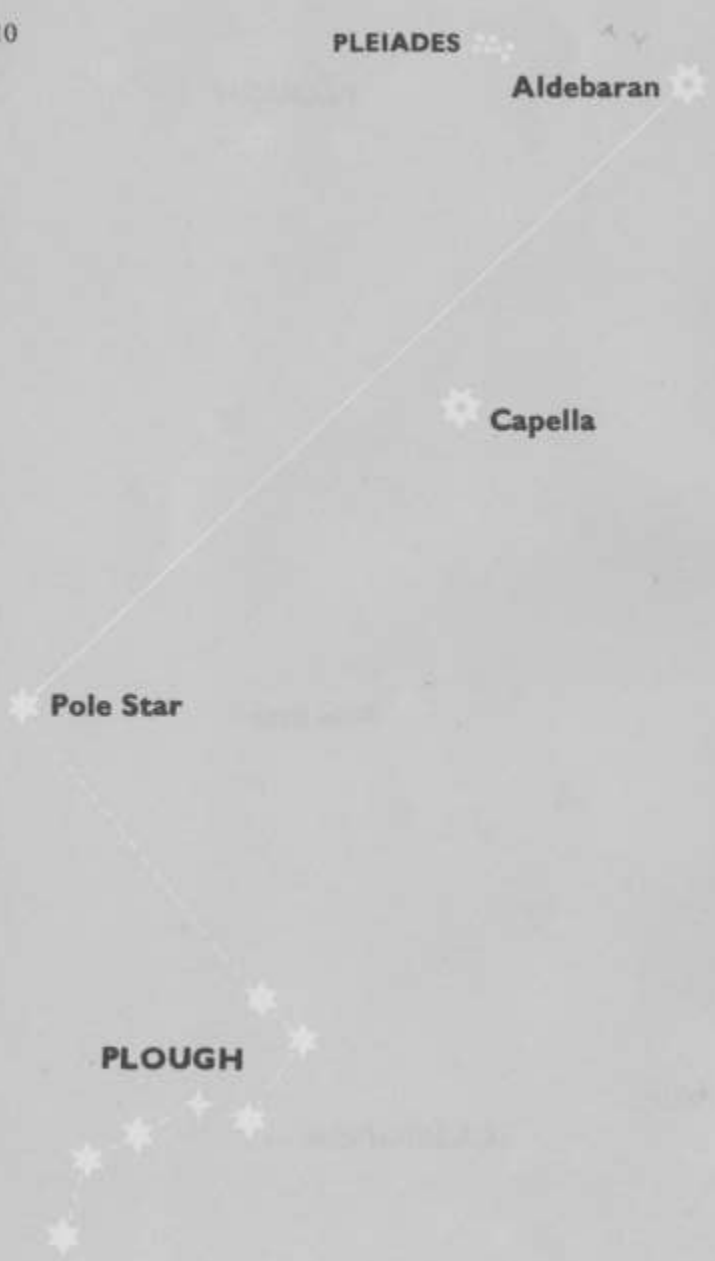
It should never be forgotten that the Pole Star is the only star that does not *apparently* change its position. Throughout the night, and throughout the year it appears constantly to continue in the same place, while all the remaining stars appear to revolve around it, but still to keep their grouping relative to each other. It is as if all the heavens were painted on a huge revolving wheel, the centre of which was the Pole Star. We in England appear to be under a position halfway along the spokes, with the rim of the wheel visible to the south, but passing below the horizon in the north.

This being so it cannot be expected that the Plough will always be seen the right way up. Sometimes it will be beyond the Pole Star upside down and because the Pole Star is not overhead the Plough will be low on the horizon. As it moves, always keeping the same arrangement and distance from the Pole Star, it will pass to half way up on the eastern horizon, then to nearly overhead when at its most southerly point, to half way down on the western horizon, and back to low on the northern horizon. All this apparent movement is completed in twenty-four hours all but four minutes, and just as much of it can be seen in one night as there are hours of darkness. By reason of the lapse of four minutes, it will also be in a slightly different position each succeeding night, but by watching at regular periods throughout the year the complete cycle can be observed.

The Plough is shown in a different position in the next diagram. An imaginary line should be drawn from the end star of the handle of the Plough to the Pole Star, and continued for half that distance again until the stars of the constellation Cassiopeia are reached. These form an immense "W" in the sky, either upright on one side or the other, or upside down, according to the angle from which they are observed.

When Cassiopeia can be placed with ease it may be possible to see in the mind's eye the chair it is said to represent. If so, that will give us something in common with the imaginative power of the early Greek poets.

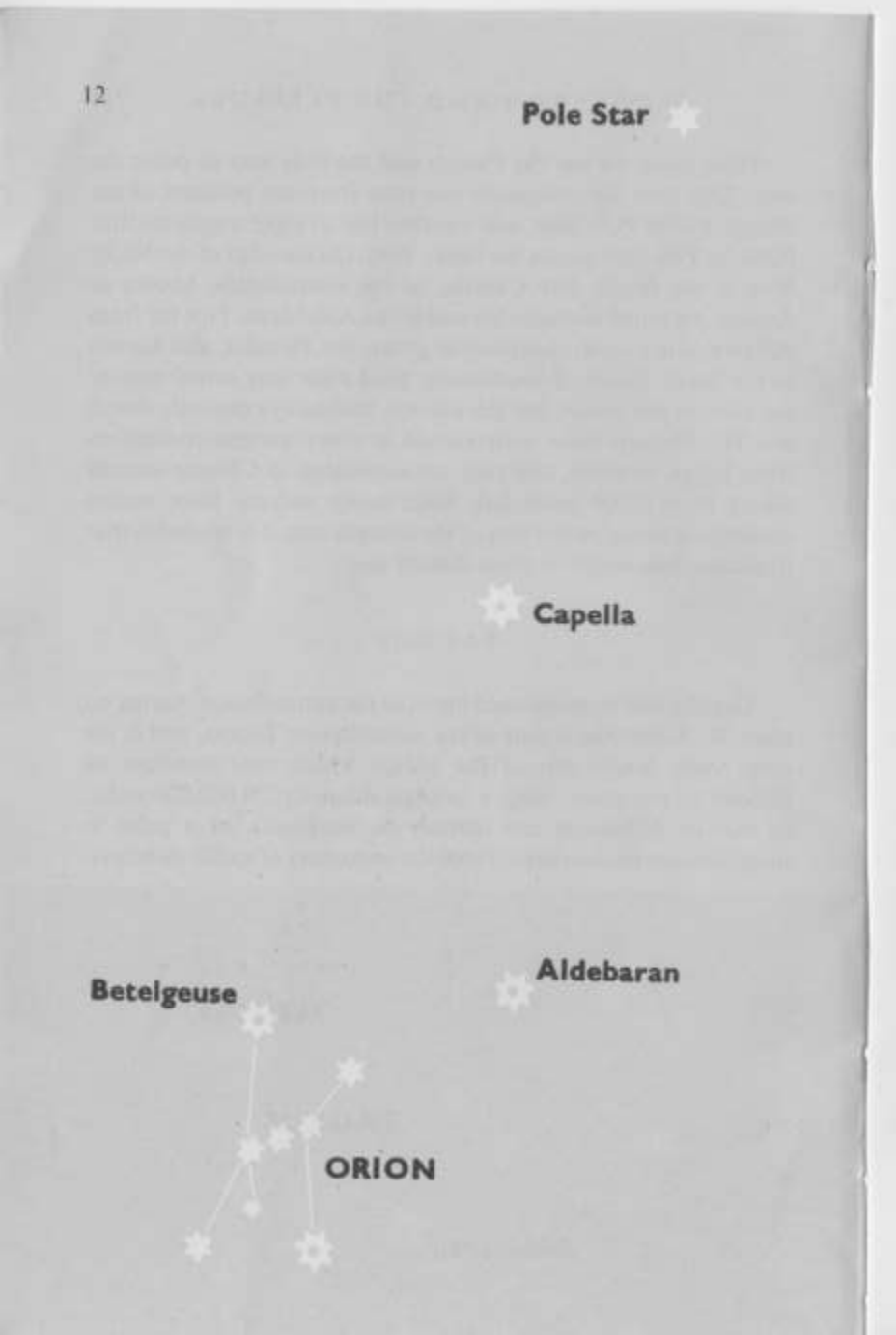

PLOUGH
Pole Star
CASSIOPEIA


PLEIADES
Aldebaran
Capella
Pole Star
PLOUGH

Once again we use the Plough and the Pole Star to point the way. This time the imaginary line runs from the pointers of the Plough to the Pole Star, and another line at right angles to this, from the Pole Star across the Milky Way. On the edge of the Milky Way is the bright star Capella, in the constellation known as Auriga. An equal distance beyond it lies Aldebaran. Not far from Aldebaran is a small conspicuous group, the Pleiades, also known as the Seven Sisters. Exceptionally good sight may reveal nine or ten stars in the group, but the average human eye can only detect six. The Pleiades have been known to every ancient civilization from Egypt onwards, and they are mentioned in Chinese records dating from 2,000 years B.C. Since many nations have stories concerning the apparent loss of the seventh star, it is probable that it became less bright in some distant age.

TAURUS

Capella will be mentioned again in the constellation Auriga on page 20. Aldebaran is part of the constellation Taurus, and is the only really bright star of the group, which may therefore be difficult to recognize. Such a colossal diameter, 34,000,000 miles, as that of Aldebaran can scarcely be imagined, yet it pales to insignificance in comparison with the immensity of stellar distances.


Pole Star
Capella
Aldebaran
Betelgeuse
ORION

It has already been explained that the Pole Star is not directly overhead, and that in their revolution round the Pole Star, certain constellations pass from low on the northern horizon, to high on the southern. Very few can be seen at all times of the year, and Aldebaran and the Pleiades belong to those that pass right out of sight below the northern horizon at certain seasons. In this they are like Orion, a group which in winter is as conspicuous as the Plough, and yet cannot be seen during the summer and early autumn. It is not comfortably in sight much before midnight at the end of October, but of course it then comes up over the eastern horizon four minutes earlier each evening and by the middle of December it is fully in view in the east at 6 p.m. and due south at midnight. It really is a striking constellation, and were it like the Plough, always with us, it would probably have been used as the starting point for this guide.

Round this brilliant group was built the story of Orion a mighty hunter, and neighbouring groups depict his animals—the Great Dog, Little Dog, Hare, Bull, Unicorn and Lion. The Bull we have already mentioned—depicted by the constellation Taurus.

In the complicated sky portrait, the centre chain of three stars represents his belt, and the brighter one below his sword. The Belt of Orion is frequently mentioned. The fame should surely be accorded to Betelgeuse, the highest star of the group, which, far larger than Aldebaran, has a diameter of 290,000,000 miles. The whole of the movement of the earth round the sun, with of course both those bodies at their present distance apart, could take place inside Betelgeuse. But Betelgeuse, reddish in colour, has only half the heat of our Sun, just something between 2000 and 3000° Centigrade. Betelgeuse is never more than half way between overhead and the southern horizon.

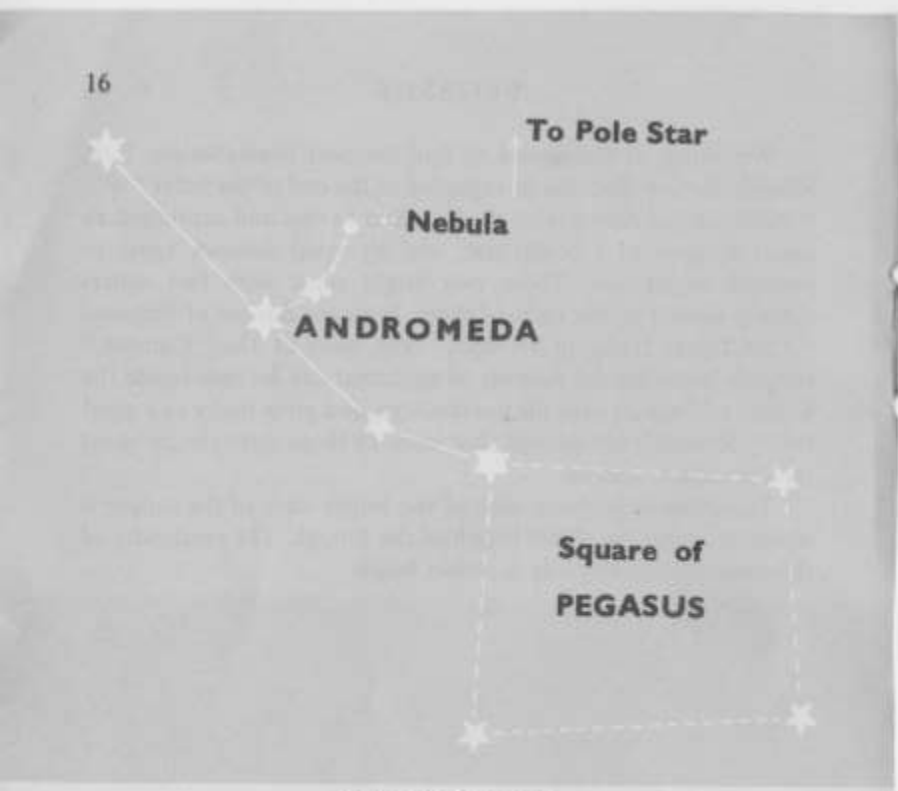
As soon as Aldebaran and the Pleiades become familiar, it will be easy to find their neighbour Orion, which is always between Aldebaran and the horizon, and to the east, or to be quite untechnical, lower down on the left of Aldebaran.


Pole Star
CASSIOPEIA
Square of
PEGASUS

We return to Cassiopeia to find the next constellation. First identify the star that can be regarded as the end of the letter "W". Visualize a line drawn from the Pole Star to that and continued an equal distance to a bright star, and an equal distance again to another bright star. These two bright stars, with two others equally spaced to the right of them, form the Square of Pegasus.

Sir James Jeans, in his book "The Stars in Their Courses," suggests counting the number of stars that can be seen inside the Square of Pegasus with the unaided eye, and gives thirty as a good result. Research has proved that some of those stars are the most remote objects known.

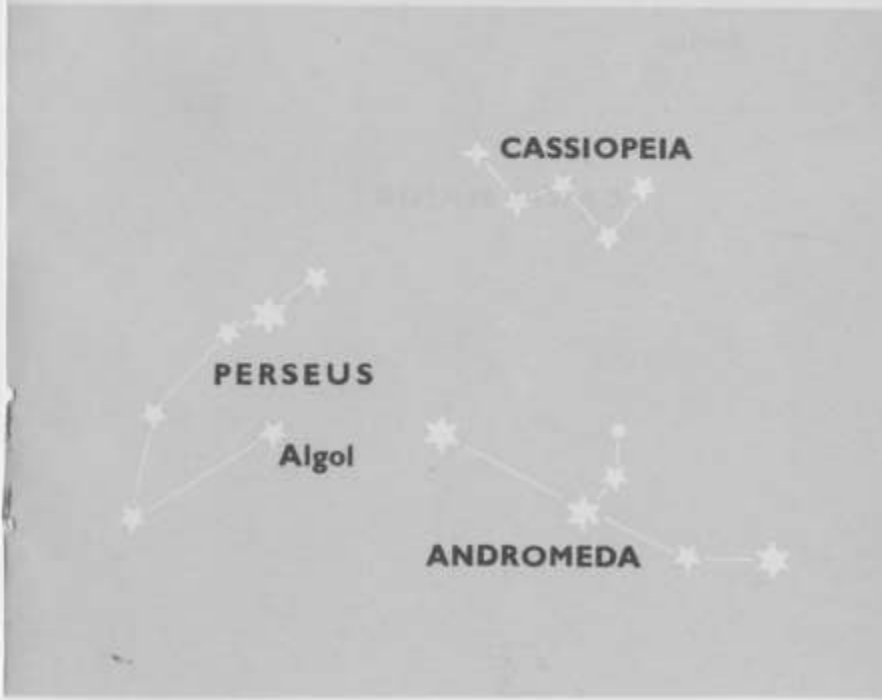
The distance between each of the bright stars of the square is equal to nearly the whole length of the Plough. The remainder of the constellation Pegasus is shown below.



ANDROMEDA

It is possible to make out a figure like a much larger Plough, of which the Square of Pegasus forms the plough-share. The brighter stars of the handle are about the same distance apart as those of the square, and are part of the constellation Andromeda. The top left hand star of the square belongs both to the Square of Pegasus and to Andromeda. The star which is the end of the handle of our new and enlarged plough has proved an interesting object for the telescope, through which it is seen to be a pair, one yellow with a smaller blue-green companion. The green star, if the telescope be a good one, is a further pair. We shall discuss another of these deceptive twins later, and also give further attention to the nebula shown in the diagram above, which although barely visible to the eye, is of absorbing interest.

Cassiopeia and Andromeda point the way to another constellation—Perseus, which has the merit of being almost directly overhead during the early winter evenings. The principal star can be regarded as a continuation of Andromeda, and the whole constellation is on the Milky Way. The star Algol is indicated, since it has long been the subject of special observation. As long ago as 1670 it was noticed to vary in brightness, and by 1782, it had been shown that these variations occurred every 2 days, 20 hours and 49 minutes. But another hundred years were to pass before it was discovered that the variation was caused by Algol being periodically eclipsed by a larger but much fainter companion star. Algol and its companion constantly revolve round each other as they travel through space, so that the brightness varies according to whether one or both stars are visible, and according to which is eclipsing the other. About 200 pairs of stars of this eclipsing type are known, though of course to the naked eye they appear as single stars.




Betelgeuse
ORION
Sirius
CANIS MAJOR

The subject of twin stars brings us to the constellation Canis Major (The Great Dog) as it contains Sirius, another twin, and the brightest of all stars to human sight. It would be unwise to assume that the star that appears brightest is Sirius, since being low on the horizon, the atmosphere is frequently not clear enough to show it at its best. Seen from the Southern Hemisphere, it always appears a much brighter star. Being half a million times as distant as the sun, its light takes eight years to reach us.

Sirius has been known as The Dog Star from very early times, but Sirius really means sparkling. As a result of its twinkling, this white star appears to sparkle with different colours in quick succession.

Sirius has a faint companion star, which from our point of view, appears to turn "cartwheels" with its big brother, instead of the more usual "ring of roses" movement of twin stars. The time of revolution is fifty years; the faint companion is the same weight as our Sun, but Sirius himself is four times heavier and twenty-five times brighter. However, the companion is notable for its extreme density, containing several hundred thousand times as much substance as the earth, in only thirty times its size. It is about twenty times farther from its big brother than the earth is from the sun. One theory is that the two stars were together in a giant supernova, which viewed from Earth was as bright as the full Moon. They were born in the explosion of the supernova several hundred million years ago and are now at their normal stage of subsequent evolution.

Canis Major is only visible in the evenings from December to March, and is lower on the horizon than Orion. It will be recalled that Betelgeuse is on the border of the Milky Way, while on the same border is Sirius, half way between Betelgeuse and the horizon. An imaginary line drawn along the Belt of Orion and continued to the left until it reaches the horizon, will have Sirius in its centre.

Since by this time some of the groups should be familiar, the next chart will show the position of three constellations. The group Auriga is half way between Betelgeuse and the Pole Star, and is situated largely on the Milky Way. Its principal star, Capella, is bright so that it has frequently been an important object of religious worship, although being about 2½ million times as far away as the sun, its light has taken 52 years to reach us. It is almost overhead in the evenings of January and February.

From Auriga, you can identify the constellation Gemini, which will always then be recognized by the two bright stars Castor and Pollux, and we can suppose that astronomers regard them with some affection since they are frequently referred to as the Heavenly Twins, if it is possible to feel affection for Castor. In the telescope it is shown to be a twin star, the pair completing a revolution in about 300 years. Further research with the spectroscope has revealed that each twin star of Castor is itself a closer twin, revolving round each other, one in 3 days, and the other in 9 days. As the telescope reveals a third adjacent star, also a twin, which moves round the other two in a period of more than 10,000 years, one hesitates to show further interest in a twin that on investigation proves to be six problem children. Pollux is 190,000,000,000,000 miles away, but has not aroused the same interest among astronomers.

The principal star of Canis Minor (The Little Dog)—Procyon, is also a double star with a history very similar to that of Sirius.

Some of these constellations may also be "signposted" from Pegasus and Andromeda. Taking the "plough" shape of these two as a guide, the bright stars of the handle, evenly spaced from the square of Pegasus, belong to Andromeda. Continuing an equal distance from here towards the Milky Way, there will be found on it the brightest star of Perseus, and in the same direction at a little greater distance is the star Capella and its bright companion in Auriga. The line may be prolonged still further to the Heavenly Twins—Castor and Pollux.

It should be remembered that these stars may be looked for in the evenings from December to March. The range of the chart is immense. The Pole Star will be half way between overhead and the northern horizon, and Canis Minor will always be low on the horizon, even when at its highest position due south.


Pole Star
URSA MINOR
URSA MAJOR
(PLOUGH)
Arcturus
BOÖTES

LEO AND BOÖTES

Late in the evenings of April and May, the Plough will be at its most southerly aspect, and a new group of constellations will come into view. The pointers of the Plough, in the reverse direction will indicate Leo, with its principal star Regulus, half way between the Plough and the horizon. In this direction shooting stars may frequently be seen. The handle of the Plough points plainly to the star Arcturus, in the constellation Boötes. Boötes is not a very brilliant group, and lies mainly between the Plough and Arcturus. The Plough, under its title Ursa Major, has its counterpart in Ursa Minor, a constellation of lesser magnitude stars that is included here for the sake of completeness.


Deneb
To Pole Star
Vega
CYGNUS
LYRA
HERCULES
Altair
AQUILA

LYRA AND SCORPIUS

The summer months of June and July may not often be dark enough for satisfactory observation, but several constellations are at their best in those months, and are included in this diagram. The constellation Lyra has a star Vega, which is the brightest star of the northern hemisphere, its nearest rival in brilliancy being Capella. (Sirius, the brightest star of all, belongs to the southern hemisphere, which is why it is always low on the horizon.) Although Vega is only about the same size as our Sun, its luminosity is fifty times greater. It is like comparing the flame of a candle with the bulb of a motor-car headlamp. Both Vega and Deneb are always visible in some part of the night sky in the greater part of the British Isles, but will be very low on the northern horizon in the winter months.

Antares, in the constellation Scorpius, is the reddest star in the sky, in addition to being a giant with a diameter about 450 times that of the sun. With all that bulk it is not surprising that Antares suffers from palpitations. It does in fact suffer a periodical contraction and expansion.

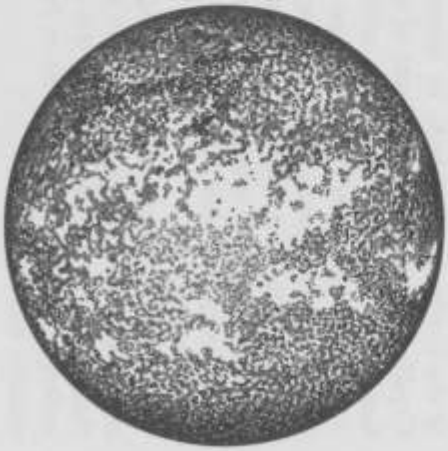
Since the Sun is the nearest star to us, and in our view the brightest, a few words of description may be welcome. We can see that it is a yellow star, and it is calculated to have a temperature of 6,000° Centigrade. It loses three hundred million tons by weight every minute, and as that "slimming" process has caused no observable difference, it may be that the sun is self-regenerating.

Size is best understood by comparing the Sun and Earth on the diagram on page 28. On the scale of this example they should be thirty feet apart.

The diameter of the Sun is 864,000 miles, 109 times that of the Earth. The greater bulk of the Sun would accommodate 1,300,000 of our Earth, if they could be packed inside it. It is 93,000,000 miles away, 400 times farther than the Moon.

The next nearest star is a very dim one in the Southern Hemisphere, and that is 270,000 times farther away from us than the Sun. Sirius, already mentioned as the brightest star, is twice as far as that.

The Sun rotates in twenty-seven days as viewed from the Earth. Its rotations have been timed by observing the sunspots, dark spots on its surface, which are really vast cavities larger than the Earth, indicating internal commotion in the Sun and eruptions on its surface. They start at the higher latitudes of the Sun and over an eleven-year period work down to its equator, at which time they break out again in the higher latitudes. A regular watch has been kept on them since 1826, but isolated records have been collated, the earliest being Chinese in the year A.D. 188. These records estab-



Spectroheliogram of the Sun

lished that the Sun is a variable star with a period of roughly eleven years, similar to the giant variable star, Antares, of which it is a feeble counterpart.

Sunspot maximum and minimum have had much investigation, but whereas attempts to blame them for the weather have not proved successful, they do prove of considerable interest to wireless enthusiasts. Both long and short wave wireless reception is at its best in sunspot maximum, but medium wavelengths prefer sunspot minimum. According to the newspapers, the outburst of sunspot activity in March 1950 coincided with much interference with television reception.

THE PLANETS

The star that we know as the Sun, is the head, and possibly the parent, of quite a large family, including many grandchildren. At great but varying distances having a mathematical relationship to each other, the planets revolve round the Sun, from which they derive most of their heat. The one best known to us is the Earth on which we live. Since those nearest the Sun are very hot (at least on the side that faces the Sun) and those farthest away extremely cold, it is certain that life as we know it, can only exist on the Earth.

The following list of the planets gives some other details about them. They are in their order outwards from the Sun:—

Name of Planet	*Distance from Sun in miles*	*No. of moons*	*Diameter in miles*	*Period of revolution round Sun*
Mercury	36 million		3,000	88 days
Venus	67 million		7,600	224 days
Earth	93 million	one	7,927	365¼ days
Mars	141 million	two	4,200	687 days
Asteroids (estimated 44,000)				
Jupiter	483 million	eleven	88,700	nearly 12 years
Saturn	886 million	ten	75,100	29½ years
Uranus	1,782 million	four	30,900	84 years
Neptune	2,793 million	one	33,000	164½ years
Pluto				249 years

The diagram above gives the relative sizes of the Sun and planets, and a further diagram on the following page illustrates their movements round the Sun.

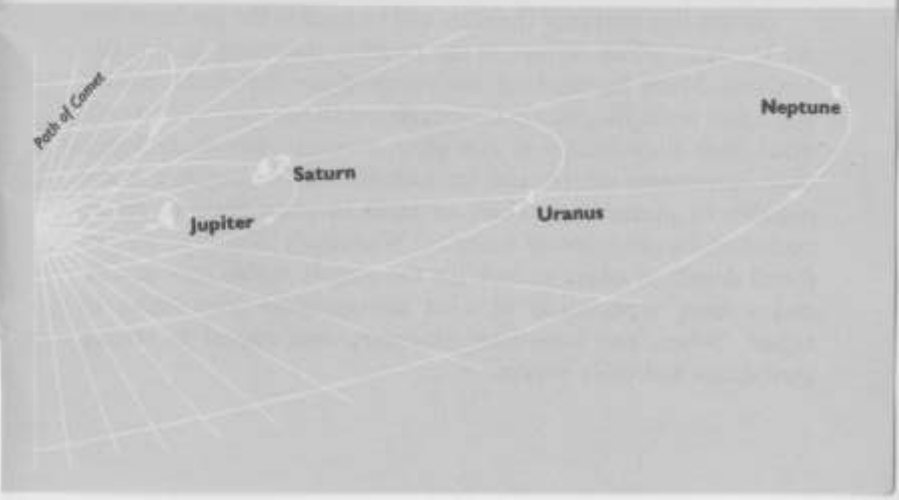
The names of the planets can be calculated outwards from the centre by reference to the list on page 27. The object passing at a sharp angle to the planets is a comet. The rays of the Sun are indicated by lines radiating from the centre. It is impossible to draw the diagram to scale. If the sun and planets were drawn the size shown above, the diagram would have to be several hundred feet across, so great are the distances concerned. On the same scale it would have to be several hundred miles across to include the nearest star.

Broadly speaking, the sizes of the planets progressively increase until Jupiter, and then decrease to Pluto, the farthest away. The size of Pluto is still a matter for conjecture. It has been found that its orbit dips into that of Neptune. It is possible that other planets exist beyond Pluto, corresponding to Mercury and Venus at the other end of the scale, but there is as yet no indication of their presence. In any case their distance, together with the fact that they only shine by reflected light from the Sun, makes research difficult. Between Mars and Jupiter there is a gap in the sequence of planets, and astronomers have found this space occupied by the belt of Asteroids. The Asteroids are small bodies from 400 miles in diameter downwards. They follow a path round the Sun between Mars and Jupiter, and a generally accepted theory is that they are the fragments of a disintegrated planet.

Although its presence was suspected, and its details predicted with quite remarkable accuracy, Pluto was not actually discovered until 1930, so it is still the subject of considerable astronomical calculation. Indeed, to obtain much of the essential data, research may have to wait until 1965, when Pluto will be at its nearest to Neptune since 976 B.C.

Many of the planets have satellites. That of the Earth is familiar to us as the Moon, which because of the coincidence of its period of rotation taking the same time as its passage round the Earth, always shows the same face towards us. In 1958, both Russians and Americans succeeded in launching artificial satellites. The rotation of the earth was used to some extent to aid their take-off, and as a result their passage appeared to be broadly from west to east. The Russian "Sputniks" travelled in an elliptical orbit, at an inclination to the equator which precluded their being visible from Earth's polar regions.

On Saturn you would usually see several moons at once, and on the occasion of a very rare coincidence might even see all its ten moons at the same time. Mars has two tiny moons, only five and ten miles in diameter. The larger one completes its revolution round Mars in about 7½ hours, and if so small a satellite is visible from the planet, the Martian observer is entertained by the sight of a tiny moon passing rapidly across the sky twice each night.



Saturn has another wonderful feature, a great ring encircling it, but this cannot be seen with the naked eye. It is shown above, and the book list (on page 3 of cover) tells where to find further descriptions of that and other planets.

No star appears in the telescope other than as a point of light, but the planets can be seen as definite discs. Nearly all can be seen by the unaided eye at some part of their orbit, the exceptions being Neptune and Pluto, which are telescopic objects only. Uranus can only just be seen without aid; Venus and Mercury are always either morning or evening stars. Venus, when visible, is the next brightest object to the Moon, and can be seen even when there is a certain amount of daylight, but Mercury is less amenable to observation.

On this day next year the stars will be back in the position they are to-night, which in turn is the position they were in this day last year. Many hundreds of years must elapse before the planets will again reach the exact position relative to the stars and to each other, that they occupy at any given moment. Hence, although their movements can be, and are foretold with accuracy, it is not possible to prepare any chart or table to show their recurring positions. In the monthly notes of Whitaker's Almanac will be found details of where to look for the planets visible that month, and a clear explanation of what astronomical phenomena to expect. Notes, and sometimes diagrams, also appear in certain periodicals and daily papers.

The Giant Nebula in Andromeda is only just distinguishable to the naked eye, but when photographed with the aid of a telescope is revealed to be a wonderful sight.

This is another complete universe of stars similar to that of which our sun and its companion stars form a part. It is an island universe. The component stars are millions of miles apart, and it has been calculated that the Andromeda Nebula as a whole is about six million, million, million miles away. The second drawing of another Nebula overleaf gives us the probable appearance of the Andromeda Nebula "edge on" and from the two we can

realize that an island universe is a disc-shaped cluster of millions of stars. The cluster is thicker in the centre than at the edge.

The great Earth on which we live is part of another island universe, of which we see the component stars around us, and of which the Sun is one of the smaller stars, nearer to the edge than the centre. Looking up into the Milky Way we are looking towards the thick part of the disc.

Beyond the millions of stars of the Galaxy, which is the name applied to our island universe, it is calculated about two million other island universes can be seen. Not all of the nebulas indicated on more detailed star charts are island universes, but for details the reader is referred to the non-technical works in the book list that follows.

To summarize, we have a giant universe consisting of several million smaller island universes, and each island universe consists of several million stars. One star at least has a family of planets revolving round it, and most of those planets are encircled by a system of satellites. Other stars may carry their systems of planets and moons, but there is at present no proof either for or against nor likely to be sufficient development in scientific instruments to establish the fact.

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Among the many attractive publications (in addition to those noted inside the front cover) for those who would like to extend their knowledge of the stars are:

STARTING ASTRONOMY. E. O. Tancock. A straightforward description with some practical exercises for the beginner. It is for those who intend to take their astronomy seriously.

BALL'S POPULAR GUIDE TO THE HEAVENS. The fifth edition of this famous work contains a detailed summary of astronomical knowledge, compressing a world of information within its covers. Features include: a star atlas and reproductions of outstanding achievements in astronomical drawing and photography. The text has been carefully revised to incorporate details of recent discoveries and research.

THE STARS IN THEIR COURSES. Sir James Jeans. A summary on the theoretical side, and brief instructions on recognizing constellations and stars.

THE STARRY HEAVENS. Ellison Hawkes. Explains in interesting manner from the planetary system outwards. Profusely illustrated, including the author's own drawings, and with the conventional figures and mythology.

A KEY TO THE STARS. R. van der R. Wooley. The theoretical side in interesting fashion, with striking illustrations.

GENERAL ASTRONOMY. H. Spencer Jones. The Astronomer Royal's book is for the reader who is not quite a beginner.

SOME FAMOUS STARS. W. M. Smart. In each chapter the author describes how observations of one well-known star solved one major problem of astronomy, and thereafter tells of subsequent developments of the investigation.

INTRODUCING THE UNIVERSE. James C. Hickey. The author, a professional journalist, has the knack of writing in an exciting manner. If he appears to draw too largely on the discoveries of his fellow-Americans, it must be remembered that the two largest telescopes in the world are in observatories in the U.S.A.

The opening of the London Planetarium has made available to visitors an exciting new aid to star study. Special projection apparatus inside a dome-shaped auditorium enables the movements of the stars to be demonstrated, and the nightly and seasonal procession across the heavens to be shown in a short space of time. Details of times of showing are given in the daily press.

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